



Slip, trips and falls on floors

Fall prevention techniques and the principal causes of falls on floors in public facilities are discussed in this data sheet. The unique safety issue is the inability to control the peoples' conditions and the rapidly changing floor conditions due to weather, spills, and other contaminants that can change the coefficient of friction on floor surfaces. Coefficient of friction refers to the mathematical ratio of the horizontal component of force required to overcome friction to the vertical component of the weight of the object, which tends to cause the friction. Slip resistance is that property of a floor surface that is designed to prevent slipping.

1. The focus of this data sheet is on commercial establishments where falls can occur frequently and in some cases, result in severe injuries. Control methods for high pedestrian traffic areas, such as retail stores, hotels, restaurants, theaters, and other public buildings will be discussed where the clientele vary from young to older people, who are particularly susceptible to serious injury from falls.

Causes

2. Falls on floors occur in various ways and from various causes. A person can slip on a spill or trip over an object, resulting in loss of balance

and a fall. A slip is a sudden loss of footing on a walkway surface resulting in an unexpected slide of the foot. This slide may lead to a severe loss of balance that can result in a fall. A trip is caused by an abrupt change in elevation causing a momentary interruption in leg swing while the body is in forward motion. The main reason people can walk on ice but slip on a wet surface in a facility is attributed to the change in the coefficient of friction caused by the wet surface. People can compensate for a different walking surface but they must first know there is a change. Clear spills, distractions or deteriorating peripheral vision may make it difficult to notice a change, resulting in a slip and fall.

3. Unsafe conditions or mechanical causes of falls are considered separately from unsafe practices and other personal causes.
4. The primary causes of slips and falls on floors are:
 - The presence of foreign substances (food, water, grease, oil, sawdust, soap, or debris)
 - Human factors including physical conditions, such as limited peripheral vision or knee function and mobility

- Unsuitable footwear (i.e., sandals)
- Poor housekeeping
- Unsafe physical conditions created by improper work procedures
- Unsuitable floor surfaces or treatments that create a low coefficient of friction when wet, or decreased slip resistance when dry
- Improper maintenance and care of floors

5. The primary causes of tripping hazards are:

- Differences in elevation (1/4 in. [0.6 cm] or greater)
- Unobserved, misplaced, or poorly designed movable equipment, fixtures, or displays
- Low profile items left in aisles or walkways
- Extension cords lying across paths of travel
- Displays, platforms, or merchandise racks protruding into traffic lanes
- Torn, curled, or loose carpeting/mats
- Holes or unevenness in the floor
- Inadequate illumination

6. A large percentage of falls stem from unsafe practices that are separate from human factors. Human factors can include age, illness, emotional distractions, fatigue, inattention, and poor vision. These contributing factors cannot be readily identified or controlled. It thus becomes important to focus on areas that can be controlled, such as eliminating unsafe conditions and unsafe employee practices that might contribute to falls. For example, do not place mirrors or other distracting decorations in areas visible from steps or approaching steps. Highlight stair edges for easy identification of a change in elevation.

Floors surface types

- 7.** A wide variety of floor surfaces are available. In office buildings, hotels, mercantile, and similar establishments, it is common to find masonry (concrete or quarry tile) floors at entrances, in lobbies, on stairways, throughout the ground floor and in upper floor corridors.
- 8.** Decorative materials, such as terrazzo, wood parquet, marble, and ceramic tile are most often used for interiors, while concrete and granite are generally considered more practical for exterior use.
- 9.** In other public areas in these buildings, the base floor, usually of concrete or wood, is surfaced with one or more of the popular resilient floor covering materials. Carpeting is commonly used on limited traffic areas in the high-end department, furniture, and specialty stores and hotels. Elsewhere, VCT (vinyl composition tile), linoleum, rubber, or plastic in either sheet or tile form will be used.
- 10.** Some flooring materials, such as wood, masonry, or the resilient types are reasonably slip resistant in their original untreated condition. Exceptions will be found among some polished masonry materials.

Use of floor coatings

- 11.** A slip-resistant floor coating can be applied by brush, roller, trowel, or spray (depending on the material applied), but can wear off quickly in high traffic areas.
- 12.** Floor coverings are available for most floor applications. Some examples are:
- Rubber or plastic particles to give a textured surface
 - Water-based, slip-resistant floor coating
 - Slip-resistant abrasive grains mixed with epoxy resins or sprinkled on top of a thin adhesive coating

- Sand, cork, or other gripping substances contained in other floor coatings

13. Check with floor covering suppliers or safety product distributors to determine the best material for the floor involved.
14. Specify special slip-resistant surfaces where the floor slopes (as on ramps or other inclines), where foreign substances may be present (as in food preparation, serving and sales areas, in restrooms and at entrances from outside) and at such locations as elevator entrances. Make sure floor surfaces can be cleaned in food preparation areas to meet local health codes.

Dressing materials

15. Materials for “treating” or “finishing” floors include wax-based products, synthetic resins and paint products.
16. For most general maintenance purposes, wax is widely used in both paste and emulsion form as a base for floor surface preparations.
17. Paint products (paint, enamel, shellac, varnish, plastic) are semi-permanent finishes used principally on wood and concrete floors.

Treatment of floor surfaces

18. Terrazzo floors may be maintained in one of the following ways: They may be treated with a semi-permanent, surfacepenetrating seal or coated with various slipresistant coatings, or they can remain uncoated and be cleaned with a neutral floor cleaner. Many terrazzo installers finish the installation by using a surface-penetrating seal.
19. The customary finishing treatment for wood floors is sanding and sealing with a penetrating sealer or coating with a solvent or water-based wood finish.
20. The use of oil on wood flooring is not recommended because it will leave a slight film unless the floor is thoroughly wiped and dried. Always use appropri-

ate commercial products, applied according to the manufacturer’s instructions, instead of oil.

21. The usual treatment for the resilient floor surfaces (those of VCT, rubber, plastic or linoleum) is to strip and clean the floor periodically, then to apply a coating suitable for the floor type, then buff or polish the floor when necessary. The coating protects the floor surface from wear, provides a slip-resistant surface, and brings out the natural beauty of the color or pattern and makes the surface easier to clean and renew.
22. Commercial floor coatings are designed to provide a slip-resistant walking surface, while providing a shiny appearance. To help prevent falls, a floor coating must impart a satisfactory coefficient of friction (COF) in addition to the other requisite properties. However, a coating product cannot be selected solely from the standpoint of its slip-resistant qualities.
23. Purchasers should specify that their floor coverings meet the requirements set forth in ASTM D-2047 slip resistance standards for coatings. Products that meet this standard are judged to be “slip-resistant.” Comparative tests of various coatings can then be made to determine which one is preferable for performance required from all standpoints, including COF, durability, and appearance.
24. Some suppliers offer a slip/anti-slip sealant that, when wet, provides a warning message to people. This is used primarily for outside entranceways in inclement weather.
25. Several manufacturers offer testing equipment that can be useful in comparing the coefficient of friction between different flooring or floor finishes. Because test results can vary widely based on how the test is conducted, be careful in comparing results between different equipment and people doing the testing. (Refer to ANSI/ASSE A1264.2-2012—Standard for the Provision of Slip Resistance on Walking/Working Surfaces.)

Procedures for treating and washing floors

- 26.** Floor maintenance in commercial and industrial establishments should be conducted during low traffic hours to minimize exposure to people.
- 27.** To keep the working area out of use until it is dry, take these precautions:
- Barricade the working area, preferably by means of rope or other material 36 to 42 in. (91 to 107 cm) high and stanchion barriers no more than 25 ft. (7.5 m) apart.
 - Provide appropriate caution signs at the principal approaches to working areas. Such signs are available from commercial suppliers.
 - When work is to be done in or near exit paths leading to stairs, doors, elevators or escalators, post signs indicating alternate routes.
 - Before working in front of stairways and escalators, block them off at both top and bottom. Block both sides of doorways and be careful not to block designated exits while the public or employees are in the facility.
- 28.** Failure to regularly and thoroughly clean walkway surfaces can be the direct cause of incidents and must be considered when floor falls in a given area are being analyzed.
- 29.** If the floor is washed with a cleaner, it should be flushed clean with clear water to remove the residue. Always use a cleaner recommended by the manufacturer for cleaning commercial floors.

Movable equipment

- 30.** Because fixtures, displays, and other portable equipment may be involved in customer falls, it is important that management provide safe equipment and that the injury prevention program places emphasis on the safe use of that equipment. It is impossible to discuss here every precaution applicable

to movable equipment. The safe practices indicated in the following paragraphs reflect the precautions most often indicated.

- 32.** Difference in elevation from the sales floor to the top of the display base can become a tripping hazard. Use of display bases and mannequins should be avoided or the edges highlighted for easy identification. Using display bases or platforms for mannequin or other displays at least 12 in. (30 cm) high also are easier to see.
- 33.** Do not use unusually shaped bases with unexpected extensions over which individuals can trip. Bases should either be round or have round corners. Do not place a display base at a counter end or at a column if the diameter of the base exceeds the width of the counter or column. When using pallets for display, use a skirt to prevent foot entrapment. This hazard also may exist on nondead front fixtures.
- 34.** Provide electrical outlets or drops to minimize the need for displays, special decorations and extension cords. Extension cords should not be placed across aisles. Where necessary, wires or cords may be installed in low profile channels/thresholds.
- 35.** Do not leave unattended stock piled or standing in aisles near the corners because falls can result. While employees are present in the area, filling shelves or stock drawers, or dressing a display,
- 36.** Close stock drawers promptly after stock has been removed. Keep stock on lower shelves facing aisles.
- 37.** Stock containers, such as baskets, boxes, bags, trays, cartons, stepladders, and kick stools must be removed from the aisles as soon as possible after they have been emptied. If prompt removal is impossible, place them out of the way to minimize tripping hazards.
- 38.** Small sale items should not be displayed on the floor, except in racks or large groups accompanied

by signs. Such objects as magazine racks, footstools or garbage pails must never be displayed in aisles directly on the floor; place them on display bases.

About housekeeping

39. Improper housekeeping accounts for a large number of customer falls. Daily cleaning procedures, to a large extent, determine the character of store housekeeping. Each employee must realize it is a part of job responsibility to maintain good housekeeping in the area, promptly report observed, unsafe or improper conditions, and following safe practices. Strong emphasis should be placed on the importance of housekeeping.
40. Foreign substances spilled or dropped on the floor must be cleaned up promptly. Train employees to pick up misplaced articles and to remove debris on the floor as soon as they spot it. This safe work practice is particularly important in areas adjoining special event displays or such sales counters as those for inflated balloons, toys and product demonstrations. Product demonstrations should include a trash can nearby.
41. Train employees to use containers behind the sales counter for disposal of trash and wrappings. If such containers are not large enough to hold the trash that accumulates during the work day, make an effort to secure larger containers, provide janitorial service more often or study the operation in an effort to reduce the amount of trash. Most importantly, trash must be kept off the aisle floors.
42. A delay in removing foreign substances from the floor can result in customer and employee falls. Consider setting up spill stations (broom, dustpan, dry mop, absorbent, etc.) and trash cans throughout the location for faster cleanup.
43. Have supervisors and employees watch for materials or spilled liquids on the floor and clean it up as soon as possible. Have an appropriate caution sign placed at the spot or station someone near it to di-

rect customers aside until the area can be cleaned. While the spot is being cleaned, direct traffic around the area.

44. Provide extra janitorial service for areas adjoining temporary food and drink stands erected for special events. Provide well-marked containers for customer use where the disposal of wrappings and containers is probable. Consider using mats to absorb spills in the event area. Mats should also have beveled edges to prevent trips.
45. During inclement weather, provide additional janitorial service to mop up extra moisture. Carpeted entryways or mats can assist in keeping floors dry. Supervisors on the floor must check periodically to see that the janitorial service is adequate to keep floors relatively dry.
46. As clothes hangers become empty, place them in hanger boxes, bags or racks so they will not fall to the floor. Promptly pick up any hangers found on floors, and remove hanger containers from sales areas as soon as they are filled. Consider using colored hangers that contrast with the floor color for easy identification.
- 46a. Restrooms should be monitored frequently for excess trash or water on the floor. Develop a housekeeping maintenance schedule for when restrooms can be inspected and cleaned.

Repairs

47. When repairs or renovations must be carried out in public areas during working hours, make arrangements to close off or otherwise safeguard the areas affected. A person should be assigned to monitor the job, making sure debris and tools do not remain on the floor, especially in traffic lanes. Make sure exits are not blocked when customers or employees are in the facility.
48. Promptly repair tears in carpets, rugs, or mats and smooth out folded or wrinkled sections. Report

open carpet seams as soon as they are noticed and have them repaired without delay. Caution signs should be placed around the damaged area to alert customers. Inspect rain mats before placement and removal so that damaged sections can be repaired or replaced, and curled-up edges should be smoothed down.

- 49.** Replace broken or uneven floor tiles. If unevenness is caused by a fault under the floor, have the condition corrected permanently. Holes can develop in flooring from wear or from rough treatment and must be filled in promptly. If wood floors become uneven because of damage or warping, take prompt measures to reduce the unevenness.

Ramps

- 50.** Ramps can be unsafe due to such factors as excessive slope, unguarded sides and lack of color contrast, among others. If a ramp appears to be the most satisfactory means of traffic movement in a specific situation, follow these safety measures:

- Have a maximum slope of 1 in. (2.5 cm) vertical to 12 in. (25.4 cm) horizontal or less.
- Apply color (striping or outlining) to provide contrast between the ramp and the neighboring floor level to draw attention to a change in elevation.
- Install a slip-resistant surface.
- Install handrails if the slope is greater than the 1-to-10 ratio or if the sides are unprotected.
- Reference Americans with Disabilities Act compliance where applicable.
- Ensure adequate lighting.

Entrances and exits

- 51.** Automatic doors operated by stepping on rubber mats or tripping a photoelectric beam are used in commercial establishments at both entrances and exits. Malfunction of doors, faulty installation of

mats, and improper maintenance and adjustment procedures can cause customer falls.

- 52.** A mat that operates an automatic door is permanently installed and must be recessed so its surface is level with that of the adjoining floor. If mats cannot be recessed, they must have beveled edges and be securely and permanently fastened to the floor to prevent curling or sliding.

- 53.** If an automatic door, which is usually made of clear glass, fails to operate properly, collisions with the closed door and falls may result. To prevent incidents of this kind, have doors clearly marked “IN” or “OUT,” and check frequently for safe operation according to the manufacturer’s specifications. Make necessary repairs promptly. When doors are inoperable, they must be securely fastened in the open position or used manually until repairs can be made. Customers and employees should be warned the doors are out of order. Signage and markings should be inclusive of the predominant language in the area or use universal signage.

- 53a.** Marking or signage should be on glass panes/structures that are not doors to prevent people from trying to walk through them.

- 54.** Floor surfaces at entrances, both inside and outside the doors, should be constructed of materials that are relatively slip resistant. Among the more desirable materials are rough-troweled concrete for external use and carpet or abrasive-impregnated tile and terrazzo for use inside and outside. Even tile and terrazzo containing abrasives, however, can become somewhat slippery when wet.

- 54a.** During inclement weather, provide additional janitorial service to mop up extra moisture. Carpeted entryways or mats can assist in keeping floors dry. Supervisors on the floor must check periodically to see that the janitorial service is adequate to keep floors relatively dry. Signage is also necessary on inclement days at entrances.

55. Thresholds or saddles must hug the floor closely. The maximum safe height in commercial establishments is 1/2 in. (1.27 cm). Thresholds and saddles should slope at the edges so they are not a tripping hazard, and be grooved or otherwise made relatively slip-resistant. Saddles must be screwed tightly to the floor with no loose or projecting screws. Repair any breaks or irregularities in the adjoining floor.

56. Repair defects in walking surfaces at entrances and exits as soon as possible when they are noticed. Pavement or flooring can become cracked, chipped, broken or dished. Joints in the entrance-way formed by butting together different materials, such as concrete and terrazzo, often become enlarged and can present tripping hazards.

Mats

57. Using mats at entrances can help minimize the slip hazard even where the walking surface is tile or terrazzo containing abrasive. The use of mats or carpeting also helps reduce the amount of moisture that may be tracked into the building during inclement weather. As a general rule, provide enough matting to allow shoe soles to dry during a normal walking pace (approximately 30 ft. [9.1 m]).

58. Make sure mats do not in themselves present tripping hazards. Permanently installed recessed mats are preferable. If not possible, use surface mats, left in position at all times, with beveled edges, and thick enough (1/8 in. [0.95 cm] minimum) and large enough not to curl or slide easily. Take care when storing mats to prevent raised ends when they are relaid. Roll mats on alternate sides each time they are stored to reduce permanent irregular surfaces.

59. Linked rubber mats have been widely used. In many instances, however, they are being replaced by vinyl plastic mats or vinyl-backed mats with carpet. Waterabsorbent, dirt trapping carpeting materials are preferred. Vinyl plastic matting does not absorb water.

60. Runner matting is available in both rubber and combination cord. Rubber seems to have fairly widespread application in aisles.

Program for prevention of falls

61. Fall prevention must be integrated into the way business is conducted, and management should have a coordinator for the injury prevention program, including fall prevention. A fall prevention program includes at a minimum:

- Management and employee accountability
- Regular floor sweeps to check for spills and debris. The frequency should be based on customer/guest traffic and the type of activity. A drink dispenser will require a higher frequency of checks than a front entrance on a sunny day.
- A system to inspect floors for defects and a process for bringing issues to management's attention so that repairs or other action can be taken to address the situation.
- A process established to complete an incident investigation to secure pertinent data, such as location, time, age, and sex of the injured person; prevailing physical conditions of the floor; operations at time of incident; type and condition of shoes worn by the injured person; names of witnesses and of employees who can testify as to the condition of the floor, whether or not they witnessed the incident and photos of the area where the fall occurred to show the physical condition of the area, etc.
- Prompt reporting of incidents to the insurance company or the proper persons in a self-insured organization.
- Summaries and analysis of incident data to determine the causes of falls on floors and the areas producing a high number of such incidents so that incident prevention efforts can be focused on specific trends, which results in maximum improvements.

- Maintenance and cleaning or a janitorial service should work in designated areas on a scheduled basis based on customer/ guest traffic and type of activities.
- Orientation programs for new employees must include basic safety training. Give emphasis to methods of preventing falls and the relationship between proper work procedures and the reduction of fall hazards.
- If the program for the prevention of falls on floors is to be successful, it is essential that unsafe conditions and unsafe practices be detected during housekeeping surveys, reported by employees, or otherwise revealed and promptly corrected.